



INSTITUTE FOR DEFENSE ANALYSES

## **The Incubator Process: Methodology**

W. M. Christenson, Project Leader

Kevin Battle

Dennis F. DeRiggi

Mary Catherine Flythe

Christina M. Patterson

Margaret R. Porteus

Armando A. Severo

Terri J. Walsh

Vikki Ziff

Robert A. Zirkle

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## **PREFACE**

This document was prepared by the Institute for Defense Analyses in partial fulfillment of the Task Order entitled “Analysis Support for the Military Operations in Urban Terrain (MOUT) Advanced Concept Technology Demonstration (ACTD),” sponsored by the Deputy Under Secretary of Defense for Advanced Technology (DUSD(AT)).

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## **EXECUTIVE SUMMARY**

This document is the first of two that describe a needs-generation and evaluation methodology that was developed and implemented in support of the Military Operations in Urban Terrain (MOUT) Advanced Concept Technology Demonstration (ACTD). This document presents the general methodology that was developed; its companion document “The Incubator Process: Implementation Experience for a Proposed Follow-on to the MOUT ACTD” (IDA D-2778) describes this methodology through the experience of one specific application.

### **A. INTRODUCTION**

The Incubator Process was born out of the MOUT ACTD program’s desire to perform the necessary groundwork for the successful launch of a proposed, urban operations-focused, follow-on program. The MOUT ACTD had been organized on the basis of requirements identified by a group of warfighters with operational experience relevant to that program. Some recognized, however, that the program’s technology search had been constrained from the beginning because some requirements had been rather narrowly defined. Having learned from this experience, the proposed follow-on effort to the MOUT ACTD intended to adopt a needs-based approach. It is the preliminary stage of such a needs-based approach that began to be referred to as the Incubator Process or, simply, Incubator.

### **B. INCUBATOR METHODOLOGY**

Incubator provides a methodology for identifying focal areas for that program’s technology search, and enables the development of support tools for data collection and the assessment of capabilities identified for each need. It is intended as a process for identifying, developing, and evaluating warfighter needs and capabilities in advance of, or at least during the very early stages of, a science and technology program. This needs-based approach involves a four-layer devolution of a warfighter need in order to identify and evaluate specific capabilities, technical solutions, and technical approaches that address that need.

This devolution involves moving through the Incubator's five basic phases:

- 1) warfighter needs definition and prioritization
- 2) warfighter needs development
- 3) warfighter capabilities development
- 4) overarching programmatic constraints/prioritization of capabilities
- 5) needs- and capability-focused decisions/downselect.

At the end of the Incubator Process, the following deliverables are available to provide a head-start to an emerging science and technology program:

- a list of prioritized warfighter needs
- a list of prioritized capabilities for each warfighter need
- a programmatically prioritized list of all capabilities
- a model-defined technology solution space and/or insights for each capability, as appropriate
- a decision on a subset of capabilities and associated needs to be addressed by the proposed science and technology program.

The benefits of establishing a more focused list of warfighter needs and capabilities for a science and technology program to address at the outset are two-fold. First, this down-select provides added focus to a program's planning and execution of its technology search, development, evaluation, and experimentation. Second, given that a program generally has a limited budget and resources, this refined list of needs and capabilities ensures that program funding and time are allocated to those areas best suited to deliver an operational payoff to the warfighter.

### **C. ROLE OF MODELING AND SIMULATION**

Early in the development of this methodology, there emerged a desire to reflect a Simulation-Based Acquisition (SBA)-type approach to conducting warfighter needs definition and development, and ultimately to feed into an overall model-test-model approach for the program. Models and simulations (M&S) were identified as a means to support the Incubator Process. Although the specific M&S tools selected will depend upon the focus and scope of the program of concern, M&S was envisioned as being helpful to this methodology in two key areas: 1) decision support (in terms of identifying/structuring the problem to be addressed and evaluating alternatives to satisfying a problem), and 2) data and insight generation.

#### **D. INCUBATOR WORKSHOPS**

The five phases of the Incubator Process are implemented through a series of brainstorming workshops involving the participation of warfighter and technical Subject Matter Experts (SMEs) who possess experience with and/or expertise in the proposed program's area of interest. A narrative is provided for each of these five workshops; it includes information on the workshop's purpose, duration, participants and observers, activities, support work, and deliverables.

#### **E. POTENTIAL INTERFACE WITH THE PROGRAM'S TECHNOLOGY SEARCH/EVALUATION PROCESS**

At the end of the Incubator Process, the science and technology program has a recommended list of capabilities and associated needs that is expected to deliver the greatest payoff within the time and funding resources and constraints of the program. The program, however, will still need an approach to evaluate technical solutions that satisfy those selected capabilities in order to be able to build a technical approach to satisfy their associated warfighter needs. Four additional workshops, which mirror the structure and process of the Incubator Process, are presented as a potential approach for evaluating technical solutions and ultimately determining the technical approach to pursue. Similar to that of the Incubator workshops, a narrative is provided for each of these four workshops.



## **A. INTRODUCTION**

### **1. Background**

During FY00, the Military Operations in Urban Terrain (MOUT) Advanced Concept Technology Demonstration (ACTD) was drawing toward the conclusion of its formal technology search and evaluation activities. The single Service- and joint-experimentation phases had been completed, and the program was preparing for its Culminating Demonstration prior to the commencement of a two-year Extended User Evaluation (EUE) period. Those familiar with the progress of the MOUT ACTD felt that there was sufficient need for a follow-on science and technology program to continue similar and corresponding work dealing with MOUT and related issues.

The MOUT ACTD had been organized on the basis of requirements as identified by a group of warfighters with operational experience relevant to that program. Some recognized, however, that the program's technology search had been constrained from the beginning because some of these requirements had been rather narrowly defined. One such example is the Thru-Wall Sensor requirement, which focused the technology search very specifically on a particular type of technology and prevented the evaluation of potential alternative means for addressing the warfighters' true need, which is, more generically, to know what is happening on the other side of an opaque wall. Therefore, in contrast to the MOUT ACTD, a needs-based, rather than requirements-based, approach began to be devised to provide technology search focus and ultimately to feed into the identification and evaluation of technical solutions within the proposed follow-on science and technology program. This shift in focus was to enable such a program to remain truer to the specifics of the needs, as defined by warfighters, without jumping too quickly to a specific capability and, ultimately, technical solution. This is important, because although a particular capability (e.g., the ability to see through a wall) or technical solution (e.g., a thru-wall sensor) may appear at the outset the best approach to pursue in addressing a particular warfighter need, analysis of multiple capabilities may yield better or at least alternative options (e.g., technical solutions that provide the ability to look through a window or to fit/look under a door/through a hole in the wall) for further consideration.

Having learned from the experience of its predecessor, the proposed follow-on effort to the MOUT ACTD intended to adopt a needs-based approach. It is the preliminary stage of such a needs-based approach that began to be referred to as the Incubator Process. Although it may appear from its origins to have been born solely to address the details and circumstances of this specific follow-on program to the MOUT

ACTD, the Incubator Process was developed with the intent of serving as a more generic methodology for the identification and incubation of warfighter needs in determining focal points for any science and technology program.<sup>1</sup>

## **2. Incubator Process: The Preliminary Stage of a Needs-Based Approach**

The Incubator was initially intended to illustrate an approach for conducting warfighter needs definition and development for a science and technology program, one year to six months prior to the program's anticipated start.<sup>2</sup> Such an approach provides a methodology for identifying focal areas for that program's technology search and enables the development of support tools for data collection and the assessment of capabilities identified for each need.

The Incubator relies upon the early and continued involvement of warfighter and technical Subject Matter Experts (SMEs) who possess experience with and/or expertise in the proposed science and technology program's area of interest; for example, MOUT, non-lethal weapons, etc. Both sets of SMEs participate to varying degrees in the Incubator's five basic phases:

- 1) Warfighter needs definition and prioritization
- 2) Warfighter needs development
- 3) Warfighter capabilities development
- 4) Overarching programmatic constraints/prioritization of capabilities
- 5) Needs- and capability-focused decisions/downselect.

The format for this approach consists of a series of brainstorming workshops corresponding to these five phases, and ongoing support work utilizing models and simulations (M&S) as tools for generating data and providing insights and decision support assistance.<sup>3</sup>

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<sup>1</sup> For the purposes of this paper, "science and technology program" has been chosen as the term to describe the type of effort to which the Incubator Process could apply. This should not be thought of as a formal science and technology program, which already has been specifically defined in terms of its purpose and technological solution focus. The use of this term is intended rather to equate to that of a science and technology program that is either newly or generically established, or still in the stage of a proposal. In order for such a program to remain true to a needs-pull – rather than a technology-push – objective, the key is to implement the Incubator Process from the very beginning of (or as soon as possible) during a program's formulation and implementation.

<sup>2</sup> It is recognized that it might not always be possible for funding to be made available to perform this type of preliminary analyses and work; however, in order to best benefit the execution and outcome of the program, the Incubator Process should be implemented as near up front as possible.

<sup>3</sup> Depending upon the goals, focus, and scope of a program and the types of questions that need to be addressed, any number of M&S tools could be chosen to generate data and to provide decision support for this methodology.

### **3. Paper Overview**

The remainder of this paper will be broken into five main sections. The first addresses the Incubator methodology in snapshot format, including its key concepts and an overview of the process. The second identifies the prominent role intended for M&S support tools in this methodology. The third provides further explanation of each in the Incubator's series of five workshops. The fourth illustrates additional workshops that might prove useful in providing an interface between the output of the Incubator Process and the assessment of technical solutions within a science and technology program. The final section directs those individuals who are interested to a corresponding document for information on an implementation example of the Incubator methodology.

## **B. INCUBATOR METHODOLOGY— A SNAPSHOT**

### **1. Key Concepts**

The Incubator is intended as a process for identifying, developing, and evaluating warfighter needs and capabilities, in advance of or at least during the very early stages of a science and technology program, which can then be used to focus the technology search for the program itself. The needs-based approach involves a four-layered devolution of a warfighter need in order to identify and evaluate specific capabilities, technical solutions, and technical approaches that address that warfighter need. Further definition of these concepts and how they will relate to one another are as follows:

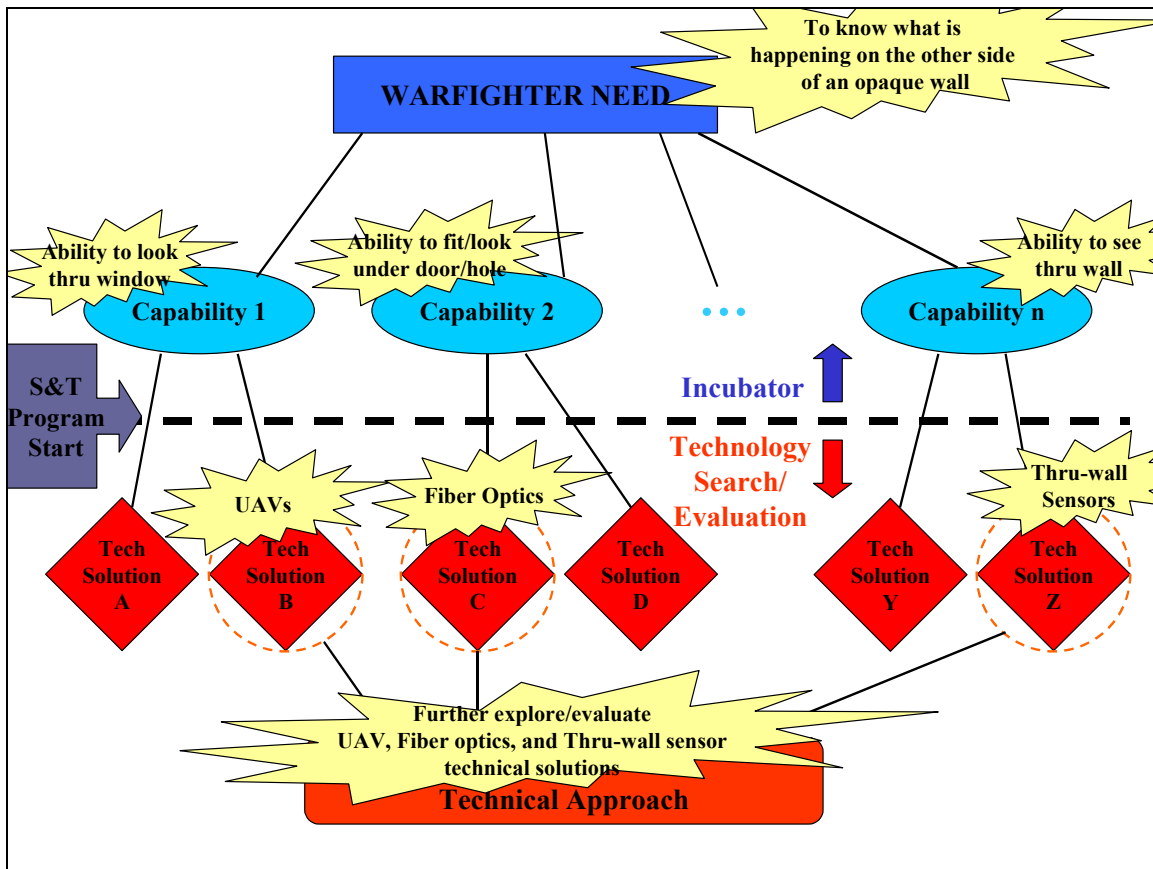
- 1) Warfighter Need – a statement of what a warfighter would like to be able to do operationally<sup>4</sup>
- 2) Capability – a general approach to addressing a warfighter need
- 3) Technical Solution – a specific technology that provides a capability that ultimately addresses a warfighter need
- 4) Technical Approach – the combination(s) of technical solutions that provide a capability(ies) and are chosen by the program as its focus for addressing a warfighter need

While each of these four layers are interconnected, the Incubator Process really only specifically addresses the concepts represented in the first two layers, warfighter

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<sup>4</sup> The warfighter need can be thought of in one of three ways: 1) an existing level of operational functionality that must be retained; 2) an improvement to an existing operational functionality; or 3) operational functionality that a warfighter is presently unable to do at all. Depending on the intent and scope of the science and technology program in question, any or all of these three types of operational functionality can be applied to the warfighters' perception of existing, evolving, and/or future threats.

need and capability. The resulting science and technology program could then benefit from the Incubator Process by building upon its needs and capabilities work to develop its own methodology for evaluating technical solutions and selecting a technical approach to pursue in addressing a need. Figure 1 illustrates how these concepts and layers are interrelated within and between the Incubator and the science and technology program's technology search and initial evaluation.

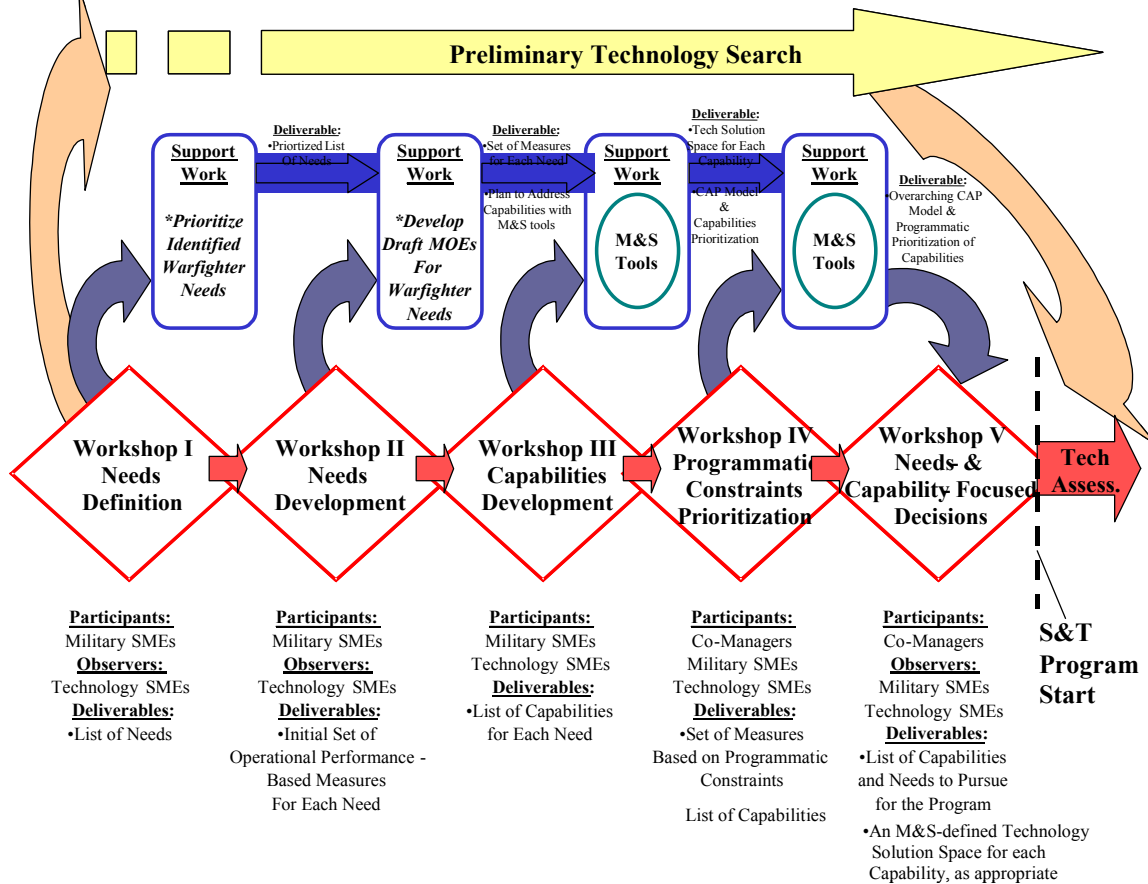


**Figure 1. Need/Capability/Technical Solution Interrelationship**



## 2. Process Overview

This devolution to the capability level and evaluation of a warfighter need within the Incubator Process is implemented through a series of workshops and corresponding support work to be convened and performed in the months leading up to the proposed start or during the very early stages of a science and technology program. Figure 2 illustrates an overview of the workflow and deliverables throughout this process.



**Figure 2. Incubator Process Overview**

The Incubator Process begins in *Workshop I* with the fundamental task of having warfighter SMEs define what it is that they would like to be able to do operationally; in other words, their need. In support of this first workshop, the warfighter SMEs provide inputs that allow a prioritized list of these warfighter needs to be produced. During *Workshop II*, warfighter SMEs commence the process of brainstorming operational performance-based measures for each warfighter need, which will be used to rate and rank capabilities identified for a particular need. Support work for the second workshop

involves a further refinement of the measures identified for each warfighter need and the development of a preliminary plan for addressing those needs. *Workshop III* brings together both technology SMEs and a subset of warfighter SMEs to brainstorm those capabilities that could provide a general approach to addressing a warfighter need. The support work necessary following Workshop III consists of utilizing M&S tools to generate data inputs and insights, as appropriate, as well as to assist in prioritizing capabilities for each warfighter need. In *Workshop IV*, a subset of the warfighter and technology SMEs assist the proposed science and technology program's manager(s) in identifying programmatic constraints to be used as an overarching set of measures for rating and ranking capabilities, regardless of the particular, individual need addressed. Support work then uses this set of measures to produce a programmatic prioritization of all the capabilities. Finally, in *Workshop V*, the proposed science and technology program's manager(s) reviews all of the deliverables from the previous workshops and support work to make a decision on that subset of capabilities and the associated needs to pursue for the program.

At the end of the Incubator Process, the following deliverables are available to provide a head-start to an emerging science and technology program:

- A list of prioritized warfighter needs
- A list of prioritized capabilities for each warfighter need
- A programmatically prioritized list of all capabilities
- A model-defined technology solution space and/or other insights for each capability, as appropriate
- A decision on a subset of capabilities and associated needs to be addressed by the proposed science and technology program.

The benefits of establishing a more focused list of warfighter needs and capabilities for a science and technology program to address at the outset are two-fold. First, this down-select of the originally defined list of all warfighter needs and capabilities provides added focus to a program's planning and execution of its technology search, development, evaluation, and experimentation. Second, given that a program generally has a limited budget and resources, this refined list of warfighter needs and capabilities ensures that program funding and time are allocated to those areas best suited to deliver an operational payoff to the warfighter.

## **C. ROLE OF MODELING AND SIMULATION**

During its early development, there emerged a desire for this methodology to reflect a Simulation Based Acquisition (SBA)-type approach to conducting warfighter needs definition and development and, ultimately, to feed into an overall model-test-model approach for the conduct of a science and technology program. The use of M&S is not intended as an end, but rather as a means to support the Incubator Process. The most appropriate models and simulations to be used in the Incubator Process will depend upon the specific focus and scope of the proposed science and technology program. In other words, M&S are tools that are selected to address, and where possible, simplify, the implementation of the Incubator for a specific program. That said, M&S is envisioned as being helpful to this methodology in two key areas: 1) decision support (in terms of identifying/structuring the problem to be addressed and evaluating alternatives to satisfying a problem); and 2) data and insight generation. In addition, depending on the number of alternatives and the volume and complexity of measures-related data anticipated, a data collection tool might be considered useful to streamline data collection and archiving, while also serving as an audit trail and facilitating the input of data into the selected decision support tool.

## **D. INCUBATOR WORKSHOPS**

This section addresses each of the five workshops envisioned for the Incubator Process in detail. Each narrative includes information on the workshop's purpose, duration, participants and observers, activities, support work, and deliverables.

### **1. Workshop I – Warfighter Needs Definition and Prioritization**

***Purpose.*** To define and prioritize warfighter needs.

***Duration.*** Two to three days.

***Participants.*** A group of 10-15 warfighter SMEs with experience relevant to the focus area of the science and technology program in question.

***Observers.*** Appropriate technology SMEs (also with experience relevant to the focus area of the science and technology program, as possible and appropriate).

***Activities.*** After a general introduction to the overall Incubator Process, the warfighter SMEs begin by reviewing any relevant requirement and/or need statements that may already exist from a previous program or other source. During this review, the warfighter SMEs may delete, change, expand upon, or otherwise revise any of these existing statements, ensuring that the resulting statements are presented in the form of a

need. Once these already existing statements have been reviewed and validated, the warfighter SMEs brainstorm any additional needs that may exist relevant to the focus area of the science and technology program. Each of these warfighter needs consists of a need title, as well as a brief further definition about what it is intended to encompass.

***Support Work.*** The support work for Workshop I can be completed almost immediately upon finalization of the list of needs by the warfighter SMEs. Each warfighter SME is asked individually to rank in order of importance a series of mission areas (e.g., offense, defense, support and stability operations) relevant to the focus area of the science and technology program. Each also ranks in order of importance all of the identified warfighter needs within each of these previously ranked mission areas. Using a methodology similar to the analytical hierarchy method and employing a rank-ordered centroid technique for calculating weights, the mission and warfighter need rankings from all of the warfighter SMEs are combined to generate a prioritized list of warfighter needs for each of the missions, and overall. The warfighter SMEs are allowed to review and revise, if necessary, these rankings to ensure that they reflect the warfighters' actual priorities. The validated overall prioritized list of warfighter needs then becomes the primary guiding document for the remainder of the Incubator's activities.

***Deliverables.*** A prioritized list of warfighter needs.

## **2. Workshop II – Warfighter Needs Development**

***Purpose.*** To commence the process of brainstorming operational performance-based measures important for each warfighter need.

***Duration.*** Two to three days.

***Participants.*** A group of 10-15 warfighter SMEs (preferably those involved in Workshop I's activities).

***Observers.*** Appropriate technology SMEs (also preferably those who observed Workshop I's activities).

***Activities.*** In Workshop II, the warfighter SMEs develop the goals' hierarchies necessary to be able to perform assessments on capabilities identified for each warfighter need. After a brief refresher overview of the Incubator Process and a more detailed introduction to any identified M&S tools, which will be used to assist in the analysis (as appropriate) and evaluation of capabilities, the warfighter SMEs address each warfighter need individually. They start with the consideration of how one will know that a

capability has satisfied a particular need. Operational performance-based measures, which one would expect a successful capability to possess, are brainstormed by need.

***Support Work.*** The support work following Workshop II will likely continue intermittently for several weeks, if not months, and does not necessarily have to be completed prior to the conduct of Workshop III or even Workshop IV. In fact, this support work is so closely tied to that possible only after the completion of Workshop III that a description of the combined, support work of both workshops can be found under the “Support Work” section for Workshop III below.

***Deliverables.*** An initial set of warfighter operational performance-based measures for each warfighter need.

### **3. Workshop III – Warfighter Capabilities Development**

***Purpose.*** To brainstorm capabilities for each warfighter need.

***Duration.*** Two to three days.

***Participants.*** An appropriate group of technology and warfighter SMEs (preferably representative of those who participated in and/or observed Workshops I and II).

***Observers.*** None.

***Activities.*** The warfighter and technology SMEs brainstorm potential capabilities to address each warfighter need. The SMEs are encouraged to be creative and to ensure that these capabilities are not too oriented to a specific technology, but rather remain at the level of presenting a general approach to satisfying a need.

***Support Work.*** This section encompasses a description of the support work that begins after Workshop II and continues after Workshop III. The major objective of this period of support work is to develop a Capability Assessment Process (CAP) model<sup>5</sup> and to generate a prioritized list of capabilities for each identified warfighter need.

CAP model development commences at the end of Workshop II with a preliminary fine-tuning of the initial set of measures defined by the warfighter SMEs during that workshop. This fine-tuning encompasses careful consideration of those types

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<sup>5</sup> A Capability Assessment Process (CAP) model is a component of the Incubator Process. A CAP model is defined, using a computer-based decision support tool, for each identified warfighter need. Each CAP model consists of a goals’ hierarchy, including goals, measures, and weightings, unique to that warfighter need. Once developed, data can be collected and entered into a CAP model for multiple capabilities; an analysis is then performed to generate a rating and ranking of capabilities within that warfighter need.

of operational performance measures for which data inputs may be appropriate for generation via the selected M&S tool. The measures are reviewed and revised an additional time after the capabilities development of Workshop III to make sure that the measures are as appropriate as possible for evaluating the identified capabilities. Once a final set of revised measures and corresponding scales<sup>6</sup> has been developed, the warfighter SMEs validate these for each warfighter need. The measures and scales having been validated, the warfighter SMEs set the relative weights of these measures within each warfighter need. Having established the above blueprint for a goals' hierarchy, a CAP model is then configured using the selected decision support tool, based on the validated measures, scales, and weights for each warfighter need.

After Workshop III, a plan for the use of the selected M&S tool to generate data, which can then serve as inputs to operational performance-based measures in a CAP model in support of the Incubator Process, can be finalized. This plan includes the careful consideration of all of the identified capabilities to determine which are suitable for M&S analysis, and then the development of any scenarios for each warfighter need, as appropriate. At this time, a list of the data inputs needed to run the M&S for each capability is also compiled.

Each capability's M&S results include some data outputs, which may then serve as data inputs to operational performance-based measures in the appropriate CAP model. In addition to these inputs, additional non-M&S-generated data are collected from the technology SMEs for each capability and entered into the appropriate CAP model. This data collection task may be facilitated by a means of electronic data collection,<sup>7</sup> depending on the volume and complexity of the data involved. Once all the data have been imported or entered, a CAP model run is performed for each warfighter need, generating the rating and ranking of the capabilities within each warfighter need.

### ***Deliverables.***

#### **Workshop III**

- A list of capabilities for each warfighter need.

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<sup>6</sup> Two examples of a measure might be Blue Losses, and Operational Risk. The scale for Blue losses could be zero to 100 percent, with zero percent being the most preferred value. This would be representative of a quantitative scale. A qualitative scale for Operational Risk might include three choices, Low, Medium, and High, with Low being the most preferred entry.

<sup>7</sup> A decision on whether an electronic data collector is needed should be made at an earlier stage while fine-tuning and finalizing the measures, scales, and weights for each warfighter need. If one is required, then it can be developed concurrently with the development of the CAP models.

#### Support Work

- A validated set of measures, scales, and weights for each warfighter need
- A CAP model for each warfighter need
- M&S model run results for each capability, as appropriate
- CAP model run results rating and ranking the capabilities for each warfighter need.

#### **4. Workshop IV – Overarching Programmatic Constraints/Prioritization**

**Purpose.** To define and develop an appropriate method for rating and ranking capabilities against programmatic constraints, for purposes of determining which capabilities and needs to address in a science and technology program.

**Duration.** One to three days.

**Participants.** Program Manager(s) and appropriate representatives of the warfighter and technology SMEs.

**Observers.** None.

**Activities.** Workshop IV begins with a review of the list of prioritized warfighter needs and the most up-to-date set of measures, scales, and weights available at that time for each warfighter need. The participants then brainstorm possible programmatic constraints, which might include such items as technical risk, available funding, etc. From this brainstormed list of programmatic constraints, a single set of measures, scales, and weights is developed to assist in determining where (i.e., which subset of capabilities, and hence needs) to concentrate a science and technology program's funds and effort.

**Support Work.** Just as the previous sets of measures, scales, and weights were used to develop CAP models for each of the individual warfighter needs, this single set becomes a blueprint for the development of an Overarching CAP model using the identified decision support tool. Such a model provides a means for evaluating all of the capabilities identified across all of the warfighter needs, based on the science and technology program's programmatic resources and constraints. Measures-related input data are then collected and entered into the Overarching CAP model and run, producing a rank-ordered list of all capabilities.

***Deliverables.***

**Workshop IV**

- A single set of measures, scales and weights that can be used to rate and rank capabilities based on overall programmatic resources and constraints.

**Support Work**

- An Overarching CAP model to rate and rank all capabilities
- A rank-ordered list of all capabilities based on programmatic resources and constraints.

**5. Workshop V – Needs- and Capability-Focused Decisions/Downselect**

***Purpose.*** To decide on the capabilities and warfighter needs to concentrate on in the science and technology program.

***Duration.*** One to two days.

***Participants.*** Program Manager(s).

***Observers.*** Appropriate warfighter and technology SMEs.

***Activities.*** The final Incubator workshop centers on a review of the deliverables from all previous workshops, and their corresponding support work. This exercise includes the review of:

- Warfighter-defined needs, as well as their prioritization, measures, scales, and weights
- M&S data results and insights per capability for each warfighter need, as appropriate
- CAP prioritization of capabilities for each warfighter need
- Overarching CAP prioritization of all capabilities, based on overall programmatic resources and constraints.<sup>8</sup>

From all this information and discussions with warfighter and technology SMEs, the program manager(s) decides which subset of capabilities and associated warfighter needs to pursue for the science and technology program.

***Support Work.*** The support work for this workshop is minimal, perhaps involving only the documentation of the workshop's activities and any decisions reached.

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<sup>8</sup> It should be recognized that by tying the assessment of needs to the realities of a program's resources and constraints, there is the potential for the program to pursue lower level, rather than higher level needs. There should be caution in the consideration of resources and constraints, so as not to allow a program to unnecessarily follow a technology-push, rather than a needs-pull, approach.



### ***Deliverables.***

#### **Workshop V**

- A list of capabilities and associated warfighter needs to concentrate on in the science and technology program.
- An M&S-defined technology solution space for each capability, as appropriate.

## **E. POTENTIAL INTERFACE WITH THE PROGRAM'S TECHNOLOGY SEARCH/EVALUATION PROCESS**

At the end of the Incubator Process, the science and technology program has a recommended list of capabilities and associated needs that is expected to deliver the greatest warfighter payoff within the time and funding resources and constraints of the program. The program is then free to develop its own methodology to evaluate technical solutions that satisfy those selected capabilities in order to be able to build a technical approach to satisfy their associated warfighter needs. Such a methodology should set in place a process for evaluating and then down-selecting from all technical solution nominations to that subset of technical solutions from which to initiate contracts and move forward into the program's experimentation phase. To do this, one might mirror the structure and process of the Incubator Process for the evaluation of technical solutions and ultimately the determination of the technical approach to pursue for a warfighter need.<sup>9</sup> The remainder of this section describes four additional workshops that could be employed to accomplish this technical solution evaluation within a science and technology program.

### **1. Workshop VI(a) – Development of Measures, Scales, and Weights for the Evaluation of Technical Solutions**

***Purpose.*** To define a technically-based set of measures, scales, and weights to rate and rank the identified technical solutions for each of the capabilities (and associated needs) being addressed by the science and technology program.

***Duration.*** Two to three days.

***Participants.*** Appropriate technology SMEs (preferably with prior experience participating in and/or observing the Incubator workshops).

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<sup>9</sup> The MOUT ACTD developed and implemented the Technology Assessment Process (TAP), a process similar in some aspects to the one presented here, in order to evaluate technology submissions with respect to a specific requirement and across all requirements within that program.

**Observers.** Several representatives of the warfighter SMEs (also preferably with prior experience participating in and/or observing the Incubator workshops).

**Activities.** During Workshop VI(a), the technology SMEs develop the goals' hierarchies necessary to be able to perform assessments on technical solutions for each of the capabilities being addressed by the science and technology program. The workshop participants receive an introduction to the proposed technical solution evaluation methodology, represented through the continuation of the needs-based approach started by the Incubator Process. This review includes a refresher on any M&S tools and the role that they serve in this portion of the methodology. The technology SMEs then develop preliminary sets of technically-based measures, scales, and weights, reflective of the warfighters' original performance-based measures for each warfighter need, which can be used to rate and rank technical solutions for each capability.

**Support Work.** The support work for Workshop VI(a) is so closely tied to that possible only after Workshop VI(b) that a description of both is located in the "Support Work" section for Workshop VI(b) below.

**Deliverables.** An initial set of technically-based measures, based on the warfighter's operational performance measures, for each capability.

## **2. Workshop VI(b) – Operational and Technical Trade-offs**

**Purpose.** To perform operational vs. technical trade-offs in order to arrive at a finalized set of measures, scales, and weights that can be used to rate and rank technical solutions for each capability (and associated need).

**Duration.** Two to three days.

**Participants.** Warfighter and technology SMEs (preferably those who participated in and/or observed at least Workshop VI(a) and the Incubator workshops).

**Observers.** None.

**Activities.** Workshop VI(b) gives the Warfighter SMEs the opportunity to review the technically-based measures developed by the technology SMEs to ensure that they appropriately capture what a technical solution to a capability needs to do operationally. During this workshop, it is anticipated that numerous trade-offs will take place between operational requirements for a capability and what is technically possible. For example, the warfighter SMEs may operationally desire the ability to see through a ten foot wall. The technical SMEs may say that this is not technically feasible within the timeframe of the program and technology maturity, or that the technical solution would end up being a

300 pound item, thus making it highly unattractive to the warfighter. However, the technical SMEs might be able to provide a 15 pound item that allows one to see through a three foot wall, which might still be seen as providing some utility to the warfighter. This is not to discount the originally expressed operational need to see through a ten foot wall, but rather to at least consider interim or partial technical solutions instead of viewing every capability or need as an all-or-nothing proposition. In going through this process of performing trade-offs between what is operationally desirable and what is technically feasible, a final set of measures, scales, and weights is agreed upon to rate and rank technical solutions for each capability.

***Support Work.*** This section's support work encompasses efforts that begin after Workshop VI(a) and continue after Workshop VI(b). The major objective of this period of support work is to develop a Technical Solution Assessment Process (TSAP) model<sup>10</sup> and generate a prioritized list of technical solutions for each capability.

Immediately following Workshop VI(a), the initial sets of measures, scales, and weights formulated in that workshop are preliminarily scrubbed. These scrubbed sets of measures, scales, and weights then serve as the departure point for the trade-off discussions between warfighter and technology SMEs in the following workshop. The final set of measures, scales, and weights that are the result of Workshop VI(b) become the blueprint for the development of a TSAP model for each capability using the identified decision support tool. Measures-related input data are collected for each of the technical solutions and entered into the appropriate TSAP model for each capability. Similar to the Incubator's CAP, this data collection process may be facilitated by a means of electronic data collection, based on an earlier decision about the anticipated volume and complexity of the data involved. Once all of the data have been imported or entered, a TSAP model run is performed for each capability, producing a rating and ranking of technical solutions in satisfying each capability.

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<sup>10</sup> A Technical Solution Assessment Process (TSAP) model is similar to the concept and construct of a CAP model, but designed to rate and rank technical solutions for each capability, rather than capabilities for each warfighter need.

***Deliverables.***

Workshop VI(b)

- A final list of measures, scales, and weights to rate and rank technical solutions for each capability.

Support Work

- A TSAP model for each warfighter need.
- TSAP model run results, rating and ranking technical solutions in satisfying each capability.

**3. Workshop VII – Overarching Programmatic Prioritization of Technical Solutions**

***Purpose.*** To define and develop an appropriate method for rating and ranking all technical solutions based on overall programmatic considerations.

***Duration.*** One to two days.

***Participants.*** Program Manager(s) and appropriate representatives of the warfighter and technology SMEs.

***Observers.*** None.

***Activities.*** Workshop VII begins with a review of the warfighter needs and capabilities being focused on for the science and technology program, as well as the operationally and technically reconciled sets of measures, scales, and weights established to rate and rank technical solutions for each capability. The workshop participants then determine any overall programmatic considerations that would be necessary and/or useful in evaluating all technical solutions.

***Support Work.*** This single set of measures, scales, and weights developed in Workshop VII serve as the blueprint for developing an Overarching TSAP model using the selected decision support tool. This TSAP model will then provide a means for evaluating technical solutions across all of the capabilities in question. Measure input data are collected and entered into the Overarching TSAP model and run, producing a rank-ordered list of technical solutions.

***Deliverables.***

Workshop VII

- A single set of measures, scales and weights that can be used to rate and rank all technical solutions based on overall programmatic considerations.

#### Support Work

- An Overarching TSAP model to rate and rank all technical solutions
- A rank-ordered list of all technical solutions based on overall programmatic considerations.

#### **4. Workshop VIII – Technical Approach Decisions**

**Purpose.** To decide on the technical approach (i.e., subset of technical solutions) to pursue further into the experimentation phase for each warfighter need.

**Duration.** One to two days.

**Participants.** Program Manager(s).

**Observers.** Appropriate warfighter and technology SMEs.

**Activities.** This final workshop focuses on the review of the deliverables from the three previous workshops, which includes:

- An operationally vs. technically reconciled sets of measures, scales, and weights for each capability
- TSAP prioritization of technical solutions for each capability
- A programmatic set of measures, scales, and weights to evaluate all technical solutions
- Overarching TSAP prioritization of all technical solutions.

In addition to this review of the rating and ranking of technical solutions for each capability and overall, the program manager(s) may ask the attending warfighter and technology SMEs to answer additional questions on the operational and/or technical merits of certain technical solutions versus others in addressing a specific capability. The program manager makes a decision on those technical solutions, which will be retained for further consideration of a capability in the science and technology program's experimentation phase. Having performed these down-selects for all of the relevant capabilities within a single warfighter need, the program manager(s) has effectively selected the program's initial technical approach to addressing these capabilities' corresponding warfighter needs.

**Support Work.** A list of technical solutions to pursue for each capability, along with the overall technical approach for each corresponding warfighter need, as decided upon during Workshop VIII, is formally documented. In addition, contracts can then be initiated for those technical solutions that comprise the selected technical approach for each warfighter need.

***Deliverables.***

Workshop VII

- A list of technical solutions to pursue for each capability
- A technical approach (i.e., a subset of technical solutions) to pursue for each warfighter need.

Support Work

- Contract initiation for those technical solutions comprising the technical approach for each warfighter need.

**F. RELATED WORK**

Once one has gained a further understanding of the Incubator methodology from this paper, one may wish to consider a related paper in this two-paper Incubator series. IDA D-2778 provides a more detailed explanation of how the Incubator Process has been implemented to date for a proposed follow-on program to the MOUT ACTD.

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